REMARKS

Claims 1 – 23 and 28 – 31 are pending in the present Application. Claims 22 and 23 have been withdrawn from consideration. No claims have been cancelled, amended, or added, leaving Claims 1 – 21 and 28 – 31 for consideration upon entry of the present Remarks. Reconsideration and allowance of the claims are respectfully requested in view of the following remarks.

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 1, 7, 10 – 14, and 16 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over FR 2840246 (FR '246) optionally in view of U.S. Patent No. 5,750,234 to Johnson et al. (Johnson) (Office Action dated February 6, 2008, hereinafter "OA 02/08", page 2) Applicants respectfully traverse this rejection.

The Office Action alleges that FR '246 teaches a process for forming an article substantially as claimed in Claims 1, 7, 10 – 14, and 16. (OA 02/08, page 2) With regard to Claims 13 and 14, it is alleged that FR '246 teaches thermoforming by a reduction of air pressure in the mold wherein "air" meets "a conformable pressure-transmitting medium." (*Id.*) Additionally, even though it is admitted that FR '246 does not specify that the resinous substrate to be heated is reinforced, it is noted that reinforcement is applied to the thermoplastic resinous substrate. (*Id.*) Therefore, it would allegedly have been obvious to one of ordinary skill in the art to add reinforcement to the resinous substrate before the initial thermoforming because FR '246 allegedly teaches that the reinforcement is capable of being thermoformed. (*Id.*) With regard to Claim 16, FR '246 allegedly teaches the resinous substrate can be a variety of polymer compositions, including polycarbonate. (*Id.*)

Applicants respectfully submit that one advantage of the present application is reduced volatile organic compound (VOC) emissions normally associated with the use of thermosetting resins, while FR '246, submitted as an attachment, is directed to improving mechanical properties of the parts thermoformed by applying fiber reinforcement to the substrate **after** one surface has already been molded. (Abstract) With respect to Claim 1, Applicants respectfully submit that the process as claimed in this application and the process in FR '246 are substantially different. The process in FR '246 contains steps such as heating a thermoplastic panel, thermoforming a first surface of the panel, applying pre-heated reinforcement to the other surface, applying an opposite

mold to the reinforcement, and welding it to the thermoformed molding. (Abstract) Conversely, Applicants' process, calls for

> heating a reinforced resinous substrate to a thermoforming temperature to form a heated substrate;
>
> contacting a surface of the heated substrate with a surface of shaped surface component, wherein the heated substrate has a sufficient concentration of heated resin at the surface thereof for bonding the heated substrate to the shaped surface component; and
>
> thermoforming the heated substrate at a pressure less than or equal to about 500 psi (3447 kPa) to provide a bond at an interface between the surface of the thermoformed substrate and the surface of the shaped surface component.

(Claim 1) The process in FR '246 at least fails to disclose "a reinforced resinous substrate" heated to a thermoforming temperature; fails to disclose "thermoforming…at a pressure less than or equal to about 500 psi (3447 kPa)"; fails to disclose a heated **reinforced** substrate having "a sufficient concentration of heated resin at the surface thereof for bonding the heated substrate to the shaped surface component"; and fail to disclose the claimed pressure. (Present Claim 1)

In fact, FR '246 discloses problems when using reinforced resinous substrates. (Page 1 of 4) Specifically, FR '246 states that when using glass fiber reinforced substrates, blemishes on the surfaces of the thermoformed parts occurs. (*Id.*) Additionally, FR '246 states that the presence of these fibers can "obstruct the stretching of the thermoplastic matter during thermoforming." (*Id.*) FR '246 further states that if fiber reinforced substrates are used, process temperatures and pressures must be raised. (*Id.*) Thus, FR '246, at best, teaches away from the present process. As a result, no suggestion, prompting, or motivation, exists to change the process of FR '246 to use a reinforced resinous substrate as is suggested in the OA 02/08. If there is any prompting, it is to avoid the use of a resinous substrate.

Since, in the present application, a reinforced resinous substrate is used and thermoforming is achieved with "pressure[s] less than or equal to about 500 psi (3667 kPa)", FR '246 fails to render the present claims obvious. Furthermore, the dependent claims add patentable distinction. For example, especially considering that FR '246 teaches the need for increased temperatures and pressures as a problem with respect to reinforced resinous substrates and that FR '246 fails to even provide any specific temperatures and pressures, thermoforming at a pressure of about 1 psi to about 500 psi (Claim 11), and even about 10 psi to about 100 psi (Claim 12), are not obvious.

Johnson is relied upon as alleged further motivation to thermoform a reinforced resinous material. The OA alleges it would have been obvious to one of ordinary skill in the art to use a reinforced resinous material taught by Johnson in the thermoforming process taught by FR '246 because Johnson allegedly teaches that finely divided particulate filler is added to a resinous top coat to provide a matte finish to the finished product before the product has been thermoformed. (OA 02/08, pages 2-3) However, FR '246 teaches away from using reinforced resinous material. As discussed above, FR '246 discloses problems when using reinforced resinous substrates. (Page 1 of 4) Specifically, FR '246 states that when using glass fiber reinforced substrates, blemishes on the surfaces of the thermoformed parts occurs. (*Id.*) Thus, no motivation, prompting, or suggestion to combine Johnson with FR '246 exists, since FR '246 teaches away from using reinforced resinous materials. The claims are, as a result, non-obvious. Reconsideration and withdrawal of this rejection are respectfully requested.

Claims 2 – 6, and 15 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over FR 2840246 (FR '246) optionally combined with U.S. Patent No. 5,750,234 to Johnson et al. (Johnson), as applied to claims above, and further in view of U.S. Patent Publication No. 2002/0182352 to Mitten et al. (Mitten). Applicants respectfully traverse this rejection.

The Office Action admits FR '246 does not mention the use of tie layers, additional film layers, compatible layers, or balance layers but alleges Mitten teaches a variety of methods can be used to produce the 3-D plastic article including thermoforming, injection molding, and blow molding. (OA 02/08, page 3) The OA also alleges that it is well known to form multilayer shaped laminates by thermoforming laminate films with two or more layers and at least one bond-promoting tie layer selected because the tie layers improve adhesion. (*Id.*) The Office Action alleges further that Mitten also teaches thermoforming the tie layers and concludes that it would have been obvious to one of ordinary skill in the art to form additional film layers and tie layers as allegedly taught by Mitten for the thermoforming process taught by FR '246 because Mitten teaches the layers are selected to improve adhesion and bonding with a superior and economical formed product. (*Id.*)

Applicants respectfully disagree and submit that Mitten teaches methods for manufacturing 3-D plastic articles including providing an extruded sheet comprising an

engineering resin layer, thermoforming a 3-D shell from the extruded sheet, and injection molding a commodity resin layer onto the thermoformed shell. (Paragraph [0037]) Another method disclosed in Mitten includes injection molding a commodity plastic resin onto a thermoformed shell and optionally using tie layers to promote adhesion. (Paragraph [0040])

FR '246 is directed to a process for creating a thermoformed substrate wherein a fiber reinforcement layer is added during thermoforming to increase mechanical properties of the part obtained. (Abstract, Detailed Description, and Figure) FR '246 does not discuss injection molding part of the substrate or using tie layers. (Abstract)

It is first noted that Mitten fails to cure the deficiencies of FR '246 discussed above. Furthermore, there is no motivation to modify FR '246 based upon teachings relating to injection molding onto a thermoformed shell. If OA 02/08 is suggesting to extract merely the tie layer of Mitten and use it in the system of FR '246, there is no prompting or motivation to make such a modification and, even if there is such a modification, the combination fails to render the present claims obvious as discussed above.

Since there was no motivation, suggestion, or prompting to combine the use of tie layers in the combined process of Mitten with the thermoforming process in FR '246, and since Mitten fails to cure the deficiencies of FR '246, these references fail to render the present application obvious.

Reconsideration and withdrawal of this rejection are respectfully requested.

Claims 2 – 6, 8, 9, 15 – 21, and 28 – 31 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over FR 2840246 (FR '246) optionally combined with U.S. Patent No. 5,750,234 to Johnson et al. (Johnson), as applied to claims above, and further in view of U.S. Patent No. 5,026,448 to Reafler et al. (Reafler). Applicants respectfully traverse this rejection.

The Office Action admits that FR '246 does not mention the use of tie layers, additional film layers, compatible layers, or balance layers but alleges that Reafler teaches it is well known in the art to form multilayer shaped laminates by thermoforming laminate films with two or more layers and at least one bond-promoting tie layer selected because the tie layers improve adhesion. (OA 02/08, page 4) It is further alleged that Reafler also teaches thermoforming the layers and, therefore, OA 02/08 concludes that it would have been obvious to one of ordinary skill in the art

to form additional film layers and tie layers as taught by Reafler, for the thermoforming process taught by FR '246, because Reafler allegedly teaches the layers are selected to improve adhesion and bonding. (OA 02/08, page 4)

Firstly, as with Mitten, Reafler fails to cure the deficiencies of FR '246. Furthermore, there is no motivation, prompting, or suggestion to modify the process of FR '246 to include a bond promoting layer. FR '246 is applying a reinforcement to a thermoplastic panel. OA 02/08 alleges that it would have been obvious to include a tie layer in the process of FR '246 but does not elaborate on how and where the tie layer would be used. There is no support for such a modification, and if the modification is between the reinforcement and the thermoplastic panel, as described above, the present application is directed to a reinforced resinous substrate. Hence, even the modification would not meet the present claims. The mere existence of elements of the present claims in various applications does not render the present claims obvious. "A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.,* 127 S.Ct. 1727, 1741 (2007). To find obviousness, the Examiner must "identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does." *Id.* The claims must be read as a whole and there must be prompting to modify or combine prior art references to attain the present claims. Since no such prompting exists, and since the references fail to cure the deficiencies of FR '246, the present claims are non-obvious.

Reconsideration and withdrawal of this rejection are respectfully requested.

With respect to Claims 15 and 31, the Office Action alleges it would have been obvious to one of ordinary skill in the art to apply a layer to the substrate opposite the side of the film layer to form a protective surface on the substrate. (OA 02/08, page 4) It is noted, however, Applicants do not claim a "layer" but claim a "balancing layer". It is not even alleged that Reafler teach a balancing layer. Furthermore, the OA admits FR '246 does not mention forming the shaped surface component by thermoforming the shape in a mold, followed by thermoforming it together with the heated substrate as recited in the claims. (OA 02/08, page 4)

Reconsideration and withdrawal of this rejection are respectfully requested.

With respect to Claims 8 and 9, the Office Action alleges it would have been obvious to one of ordinary skill in the art to thermoform a preformed layer by either not removing it from the mold or by placing it in a second thermoforming mold and further thermoforming the compatible layers because Reafler teaches that sequential thermoforming improves the desirable surface qualities when such materials are stretched by thermoforming and bonding to a substrate. (OA 02/08, pages 4-5) However, what Reafler states is:

> The present invention provides an improvement in the use of protective and decorative sheet materials intended for thermoforming bonding to three-dimensional substrates such as exterior or interior automobile parts, appliances, and the like. The improvement reduces the potential for loss of desirable surface qualities when such materials are stretched by thermoforming and bonded to a substrate. It also offers advantages with respect to a wider selection of clearcoat materials and to the covering of highly contoured substrate surfaces, as will be further described.
>
> More specifically, this invention relates to a method of forming a glossy protective and decorative basecoat-clearcoat surface on a three-dimensional substrate which comprises
>
> heating, stretching and bonding a thermoplastic basecoat sheet to the substrate,
>
> heating a thermoplastic clearcoat sheet, and
>
> stretching and bonding the heated clearcoat sheet to the basecoat sheet on the substrate.

(Col. 2, lines 25 – 45) Reafler does not disclose or suggest the process of: "the thermoformed surface component is cooled in the mold, then contacted with the heated substrate without removal from the mold" (Claim 8), or

> removing the thermoformed surface component from the mold, and placing the thermoformed surface component in or on a second mold prior to contacting with the heated substrate.

(Claim 9) There is no support for the contention in OA 02/08; the claims are non-obvious. Reconsideration and withdrawal of this rejection are respectfully requested.

With respect to Claims 20 and 21, the Office Action alleges it would have been obvious to one of ordinary skill in the art to thermoform a preformed layer and separately thermoform the compatible substrate layer, and further thermoform or adhesively bond together because Reafler

allegedly teaches that sequential thermoforming in separate steps improves the desirable surface qualities when such materials are stretched by thermoforming and bonded to a substrate. (OA 02/08, page 5)

Applicants note that Reafler discloses a particular process and advantages associated with that particular process. Reafler does not disclose or suggest the extensions alleged in OA 02/08. The elements of Claims 20 and 21, as well as the other dependent claims, are not known or obvious. If official notice is being taken, written support for such notice is respectfully requested.

The process in Reafler does not include thermoforming a preformed layer, separately thermoforming the compatible substrate layer, and then thermoforming or adhesively bonding the two layers together. Instead, Reafler teaches that a basecoat sheet, having no adhesive layer, is placed in a mold and then a substrate plastic is injected into the mold at elevated temperature and pressure to heat, stretch and thermally bond to the basecoat sheet. (Col. 4, lines 1-5) As a result, Reafler fails to cure the deficiencies of FR '246.

Reconsideration and withdrawal of this rejection are respectfully requested.

With respect to Claims 16-19, and 28-30, the Office Action admits that FR '246 does not disclose that the surface component comprises an arylate polyester or the polymers mentioned in Claim 30 and does not include a compatible layer with an additive for an aesthetic effect but alleges that Reafler teaches a paint coated basecoat sheet (which the OA alleges qualifies as a compatible layer with an additive for aesthetic effect) bonded to a carrier film and bonded to a substrate by thermoforming with the clearcoat sheet and optional tie layers to improve bonding of the paint layer to the carrier film. (OA 02/08, page 5) The Office Action alleges further that Reafler teaches the clearcoat sheet, including the surface component, can be made from the polymers listed in Claims 28-30. (OA 08/07, page 5) The Office Action concludes it would have been obvious to one of ordinary skill in the art to use the composition of surface component, added tie layers, and compatible layers as taught by Reafler with the thermoforming taught by FR '246 because Reafler allegedly teaches that the polymers form films that will stretch when heated during the thermoforming process and provide a smooth, glossy topcoat and because Reafler allegedly teaches that the tie layer improves bonding. (OA 08/07, pages 5-6)

Applicants respectfully disagree and submit that the OA has not provided any motivation, prompting, or suggestion to combine the thermoforming process taught by FR '246 with the use of basecoat and clearcoat layers taught by Reafler. No *prima facie* case of obviousness has been established. There is no mention in FR '246 of bonding, or of additional layers. What is disclosed in FR '246 is reinforcement from a thermoplastic sheet made of two layers of parallel reinforcing fibers and this reinforcement is applied to a second surface after the first surface has been heated for thermoforming. (Abstract) There is no motivation or suggestion to combine the references in the manner suggested by the Office Action. Additionally, as noted above, Reafler fails to cure the deficiencies of FR '246 described in detail above.

Reconsideration and withdrawal of this rejection are respectfully requested.

It is believed that the foregoing remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and withdrawal of the rejections and allowance of the case are respectfully requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 50-3622.

Respectfully submitted,

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total width lies between 60 and 250 millimetres.

The present invention relates to the technical field of composite materials. More particularly, ['object of ['invention concerns a new pro yields to format and renforc er a thermoplastic part of matter, as well as the composite parts renforcees and in form likely to be obtained by such a process. Many branches of industry, such as the fields of packing, the car industry, or of the construction trade, use thermoplastic matter parts of form variee. Most of these parts wind obtained by thermoforming, process gathering various techniques allowing, from thermoplastic matter parts in the general shape of plate, to obtain pipe fittings thickness let us quasicons/handle. This technique, largely utilisee, include/understand, like principal stage, a stage of working of a thermoplastic matter plate beforehand chauffee has a sufficient temperature to authorize its deformation. This working can be effectuee by various means, for example by stamping of the plate between a mould and a against-mould or by positioning the plate on a mould in which a depression is appliquee, in order to come to plate by aspiration the composite part against the walls of

the print of the motile one.

These techniques of thermoforming of thermoplastic parts, well-known of the man of ['art, present various advantages, such as the setting in ceuvre of tools of low cost and the possibility of manufacturing parts of relatively important size and this A of faster rates qutavec of the technologies put in aeuvre on the thermohardening matters. Nevertheless, this technique presents a major disadvantage which lies in the weak mechanical properties of the pipe fittings obtained. The solutions suggested by former art, consist primarily, has to reinforce the pipe fitting with plate, intended has to be thermoformee. For that, it is for example proposes Co-to extrude the thermoplastic matter with fibres of reinforcement, generally of glass fibres races, long or continuous. However, such solutions do not give entiere satisfaction, because they generate blemishes on the surface of the parts thermoformees obtained. Moreover, the presence of fibres can obstruct the stretching of the thermoplastic matter during thermoforming. In addition, such techniques entranent important modifications of the process of thermoforming, in particular ['increase in the temperatures of transformation utilisees and the need for putting in ccuvre a mould and a against-mould has more raised pressures which

bring closer the pressures utilisees in thermocompression.

In this context, the present invention proposes to provide a new process to format and to reinforce a thermoplastic part of matter, the aforementioned process making it possible to improve the mechanical properties of the part obtained, all

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by preserving a satisfying aspect of surface of the part.

Another object of ['invention, is to propose a process which is also easy A to put in ccuvre, using tools close to that put covers some in the techniques of plastic thermoforming, being able to be bracket has fast rates

and allowing to manufacture parts of great dimension.

To achieve such goals, the process to format and to reinforce a thermoplastic matter part according to ['invention, includes/understands successively the following stages: a) to heat a thermoplastic matter part in the general shape of plate, a first large face of the part being chauffee has a temperature authorizing its later thermoforming and the second large face has a temperature higher than the melting point of the matter thermoplastic and lower than the breaking down temperature of the aforesaid the matter; b) to thus place the aforementioned part chauffee on motile, the first face being intended has to be positionnee against the walls of the print of the mould and thermoformer the part; c) on at least part of the second large face of the part thus thermoformee, the aforementioned face being always has a temperature higher than the melting point of the thermoplastic matter, to apply a reinforcement in the general shape of plate containing fibres of reinforcement and of an identical thermoplastic matter that of the part has, the aforementioned reinforcement having been beforehand heating has a temperature higher than the melting point of the thermoplastic matter and lower A its breaking down temperature; d) on the reinforcement, to apply a against-mould with a sufficient pressure to ensure working of the reinforcement and its welding with the part thermoformee, the temperature of the

reinforcement and that of the second face of the part being always has a temperature higher than the melting point of the thermoplastic matter; e) ['unit part thermoformee/reinforcement maintained between the mould and the contremoule is cooled to obtain the hardening of the thermoplastic matter. The present invention also has as an aim the composite parts renforcees

and in form likely to be obtained according to the process above.

Various other characteristics arise from made description cidessous in

reference to the drawings annex which show, as nonrestrictive examples, of

embodiments of ['object of ['invention.

. 1, 2, 3 and 5 wind of the diagrammatic sights of the stages of the process according to

1 5 ['invention.

. 4 is a sight in prospect partially arrachee of an example for

reinforcement which can be uses in the process according to ['invention.

. 6 represents a composite part forms some and renforcee obtained according to

the process of ['invention.

. 7 illustrates an alternative of the process according to ['invention.

The process according to ['invention comprises a first stage has) consist has to heat a thermoplastic matter part 1 in the shape of plate, intended has to be formatted, then renforcee. By thermoplastic matter part, one understands a part manufactured starting from a thermoplastic matter such as polypropylene, polyethylene high density, polyethylene low density, ltethylenvinylacetate (EVA), polystyrene, the poly (methyl methacrylate), the poly (vinyl chloride) (PVC), polyamides or polycarbonates. Of course, these thermoplastic polymers can be combine with various additives of the type plasticizing, surface-active, lubricating, antioxydant, dyes, opascifiants, absorbent W. inflating agents, mineral or organic loads, in order to modify their characteristics. I1 is also possible to use parts manufactured starting from a mixture of

thermoplastic polymers above mention.

Thermoplastic the starting matter part is in the general of plate and present shape, for example, a thickness of 1 A 50 Misters. The heating of the aforesaid the part can be carries out by various means, such as by conduction, convection or radiation. The thermoplastic part is generally maintained within a framework 2 of maintenance and of support to be subjected a heating has, advantageously while placing it between two slopes has infra-red radiation, in order to heat the two large faces it and lb of the aforesaid the part. One of its large faces, for example the face it is intended has to be positionnee against walls 3 of print 4 of mould 5 being useful later on in ltetape of thermoforming. This first large face

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is chauffee has a sufficient temperature to authorize its later thermoforming.

Of course, the temperature of heating must be lower than the breaking down temperature of the thermoplastic matter. The heating will be, for example, carries out has a temperature ranging between the temperature of softening and the temperature

of fusion of the thermoplastic matter.

The second large face lb, as for it, is intended has to be put later on in contact with a reinforcement 7 and must be chauffee of course has a temperature higher than the melting point of the thermoplastic matter and, lower than the breaking down temperature of this behind, so as to allow the welding of the part reinforcement 7, such as that will be explains in the continuation of

description. Advantageously, this second face lb will be chauffee has one

temperature slightly higher than the melting point of the thermoplastic matter, for example has a temperature of 5 A 20 C higher than the melting point of the thermoplastic matter. The stage b) of the process, consists has to thus place the aforementioned part chauffee on motile, so that the first face of part 1 is placee opposite ltempreinte 4 of mould 5. The

stage of thermoforming is advantageously effectuee by applying a depression 6 to mould 5. This depression makes it possible to aspire plate 1 in print 4 of mould 5 by stretching and deforming the thermoplastic matter to come to plate the face part 1 against walls 3 of print 4. As shows it. 2, part 1 adopts the form of print 3, correspond to the form wished for the final composite part. Of course, another technique of thermoforming, such as ltestampage pourra^t to be utilisee, the only condition has to respect being to preserve for the face lb part 1 a temperature higher than the melting point of the matter

thermoplastic, for the setting in ccuvre of the later stages c) and D).

The stage c) consists has to thus position on part 1 thermoformee, a reinforcement 7. This reinforcement 7 can be designed to reinforce the totality of part 1 and will be gives bracket on all surface lb or to carry out of a local reinforcement and will be then applies only to the part concerned of the face lb. This reinforcement also in the general shape of plate east composes, on the one hand, of fibres of reinforcement and, of other

leaves, of an identical thermoplastic matter has that constitutive of part 1.

Various reinforcements 7 could be use. Generally, such a reinforcement comprises at least a fibrous tablecloth made up of fibres of reinforcement, such as carbon, glass fibres or aramide, possibly in mixture. Such a fibre tablecloth can be appeared as a fabric or of a non-woven material, the fibres being able to be orientees in way mono, Bi or pluri directional. This fibrous network east combines has a thermoplastic matter matrix, being presented for example in the shape of a film to which the fibres wind closely dependent. In an advantageous way, one will use a homogeneous reinforcement in which the fibres wind comelees with the thermoplastic matter. The reinforcement presents in an advantageous way a thickness ranging between 0,1 A lOmm. As example. 4 illustrates an example of reinforcement 7 which is composed of a sheet 8 out of associated thermoplastic matter has a first tablecloth 9 of wire of reinforcement extending in parallel between them and has a second tablecloth 10 of parallel wire of reinforcement between them and transversely extending to first tablecloth 9 without interlacings. According to another alternative, such a reinforcement will be able to comprise only a senle tablecloth of wire of reinforcement stetendant in parallel between them, cesdits wire of reinforcement which can be cdmeles with wire of thermoplastic matter of comparable nature or different nature that the matter constitutive of film 8. The tablecloths can be made up of jointed wire or of wire lay out in beams spaces regularly. Film 8 can have a thickness ranging between 25 and 1.200, um, its surface mass being able to lie between 20 and 1.000 g/m2. If necessary, the wire constitutive of the tablecloths can be textures. Film 8 and the wire wind network closely dregs so that the wire wind print at least to some extent in the thickness of film 8 without qut it results a surface quality from it deforms. Such reinforcements wind carried out according to traditional techniques', for example by hot calendering

under conditions of well-known temperature and pressure of the man of ['art.

Reinforcement 7 uses in the process according to ['invention is characterized by a faculty of elastic strain giving him an aptitude for conformation at the time of the stage

later D).

This stage D) consists has to apply to reinforcement 7 a against-mould 11 with a sufficient pressure to ensure working of reinforcement 7 and its welding at piece-rates 1 thermoformee. It is important that between the stage has) heating of part 1 and the stage D) of compression, the temperature of the reinforcement as that of the second face of the part remain tonjours higher than the melting point of the thermoplastic matter. This is why, the various stages has) quickly has D) wind enchanees, in order to avoid a too important cooling of the two elements has to associate. The reinforcement preheats 7 east gives positions on part 1 thermoformee, immediately after working of this one, then against-mould 11, also calls punch is descended at once. The pressure appliquee on the punch, when mould 5 and its contremoule 11 wind in position fermee as famous with. 5 lies, for example, between O, l.lOs and 106 Pa,

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advantageously has 0,5.105 Pa equalizes.

The elongation of the thermoplastic matter at the time of the stage of thermoforming which can entraner of light differences in thickness, lthomme of the trade will be able to envisage to adapt against-mould 11 consequently, in order to obtain a good welding

without disturbing ['aspect of surface of the part.

The part renforcee forms some thus obtained is then cooled between mould 5 and against-mould 11 always in position fermee. Then the part is finally demoulee and possibly decoupee according to dimensions of ['desired final article. . 6 watch a diagrammatic cross-section of a composite part I obtained according to the process of ['invention. This composite part I is made up on the one hand part 1 thermoplastic and reinforcement 7 closely dregs and both formatted

according to the form imposee by mould 5 and its against-mould 11.

According to a mode of realization prefers, one will be able to use a mould 5 and one against-mould 11 whose prints and counters impressed wind not exactly complementary. The use of a print and a contreempreinte not congruantes allows, as famous with. 7, to carry out a local welding enters reinforcement 7 and part 1 by sparing spacings 12 between these two elements. The presence of such spacings 12 makes it possible to improve rigidity of the composite part

S forms renforcee of it obtained.

The composite parts forms renforcees of it likely to be obtained by the present process are distinguished from the known parts of former art by their mechanical properties ameliorees Al has a satisfying surface quality. Qutil should be noticed is essential in the process according to ['invention to carry out the lO reinforcement after ltetape of thermoforming, so precisely obtaining a state of

surface satisfying.

The composite parts according to [?invention could be utilisees for the manufacture of articles in particular in the car industry and the building, such as housings under engine, of the passages of wheel of truck, the shelves postponed, the panels of trunk, the parts resistant to the shock (bumper, shock absorbers, beams), of the parts of protection external of cross-country vehicle, of the < < hardtop > > , of the residences of spare wheel, the containers, of

pallets, of the elements of bathroom or the luggage.

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diverge modifications can be there apportees without leaving its framework.

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CLAIMS

1- Process to format and to reinforce a part (1) of thermoplastic matter including/understanding the following stages successively: a) to heat a part (1) of thermoplastic matter in the general shape of plate, a first large face (it) of the part being chauffee has a temperature authorizing its later thermoforming and the second large face (lb) has a temperature higher than the melting point of the matter thermoplastic and lower than the breaking down temperature of the aforesaid the matter; b) to thus place the aforementioned part (1) chauffee on a mould (5), the first face (it) being intended has to be positionnee against the walls (3) of the print (4) of the mould (5) and thermoformer the part (1); c) on at least part of the second large face (lb) of the part (1) thus thermoformee, the aforementioned face being always has a temperature higher than the melting point of the thermoplastic matter, to apply a reinforcement (7) in the general shape of plate containing fibres of reinforcement and of an identical thermoplastic matter that of the part has, the aforementioned reinforcement having been beforehand heating has a temperature higher than the melting point of the thermoplastic matter and lower A its breaking down temperature; d) on the reinforcement (7), to apply a against-mould (11) with a sufficient pressure to ensure working of the reinforcement (7) and its welding with the part (1) thermoformee, the temperature of the reinforcement (7) and that of the second face (lb) of the part being always has a temperature higher than the melting point of the thermoplastic matter; e) ['unit part thermoformee/reinforcement maintained between the mould (5) and the contremoule (11) is cooled to obtain the hardening of the thermoplastic matter. 2 - Proceeded according to the claim 1, characterizes in that has ltetape b) it

thermoforming of the part is obtained by depression (6) of air in the mould.

3 - Proceeded according to claim 1 or 2, characterizes in that the print of the mould (5) and the fossil imprint of the against-mould (11) wind selected in way qutapres application of the against-mould has the stage D), there are spacings (12)

between the reinforcement (7) and the part (1), ntetant welding carries out that locally.

4 - Proceeded according to claims' 1 has 3, characterizes in that the reinforcement (7)

apply has the stage c) is composed of a sheet (8) out of associated thermoplastic matter has a first tablecloth (9) wire of reinforcement extending in parallel between them and has a second tablecloth (10) parallel wire of reinforcement between them and stetendant

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transversely with the first tablecloth (9) without interlacing.

- Proceeded according to claims' 1 has 4, characterizes in that the reinforcement applies

the stage has c) is composed of at least a film (8) of thermoplastic matter combines has at least a network (9) wire of tended reinforcements, comeles with thermoplastic matter wire.

6 - Process according to one of claims 1 has 5 put in ccuvre for the realization

articles in the field of ['car or the building.

7 - Composite parts (I) renforcees and in form likely to be obtained according to

Producing reinforced thermoplastic composite molding, heats thermoplastic panel surfaces selectively for thermoforming and bonding of reinforcement

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- european: B29B13/02D; B29C51/00C; B29C51/16B; B29C70/08C; B29C70/20A; B29C70/34B; B29C70/46B; B32B27/12
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Abstract of **FR2840246**

The thermoplastic panel (1) is heated. One surface (1a) is heated for thermoforming, the other surface (1b) is heated above the fusion temperature, but avoiding degradation. In the mold (5) the first surface is positioned against the wall (3) of the cavity (4). It is thermoformed. Reinforcement (7) is applied to the other surface (1b) still above its fusion temperature. It is similarly-shaped, made of the same material and pre-heated above the fusion temperature, without causing thermal degradation. An opposite mold (11) is applied against the reinforcement, which is welded to the thermoformed molding, still above the fusion point. The assembly is cooled in the mold to cause setting. Thermoforming is achieved by a reduction of air pressure in the mold. The mold cavity and that of the opposite mold, are selected such that after application of the latter, spaces (12) remain between reinforcement and the panel (1), welding only being effected locally. The reinforcement is a sheet of thermoplastic with first and second layers of parallel reinforcing fibers, the first layer being orientated at right angles to the second. The reinforcement is a thermoplastic film with a network of tensile threads combined with thermoplastic threads. An Independent claim is included for composite moldings produced as described.